Long-term VHE γ-ray monitoring of bright blazars with a dedicated telescope

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Introduction Since the termination of the HEGRA observations, the succeeding experiments MAGIC and H.E.S.S. have impressively extended the physical scope of gamma ray observations by detecting tens of formerly unknown gamma ray sources and analyzing their energy spectra and temporal behavior. This became possible by lowering the energy threshold from 700 GeV to less than 100 GeV and increasing at the same time the sensitivity by a factor of five. To fully exploit the discovery potential of the improved sensitivity, the discovery of new, faint objects has become the major task for the new telescopes. It is obvious that monitoring observations of strong blazars are orthogonal to their mission. But there are strong reasons to make an effort for the continuous monitoring of the brightest blazars. This can be achieved by operating a robotic dedicated monitoring telescope based on a technological upgrade of one of the former HEGRA telescopes, referred to in the following as DWARF (Dedicated multiWavelength Agn Research Facility).

Science case The variability of blazars, seen across the entire electromagnetic spectrum, arises from the dynamics of relativistic jets and particle acceleration. The jets are launched in the vicinity of accreting supermassive black holes. Theoretical models predict variability arising from the interplay between jet expansion, particle injection, acceleration and cooling, see e.g. Böttcher (AAS, 2003). An understanding of this variability will deepen our knowledge about

- the composition and generation of the jets, intimately connected to the physics of the ergosphere of rapidly spinning black holes embedded into the hot plasma from the accretion flow.
- the plasma physics responsible for highly efficient particle acceleration, bearing similarities to plasma physics of the interaction between extremely intense laser beams and matter.
- the orbital modulation of jets due to binary black holes expected from galaxy merger models, predicted by Rieger & Mannheim (A&A, 2000).

Assuming conservatively the performance of a single HEGRA-type telescope, long-term monitoring of at least the following blazars is possible: Mrk421, Mrk501, 1ES 2344+514, 1ES 1959+650, H1426+428, PKS 2155-304. At least one of the proposed targets will be visible any time of the year. For calibration purposes, some time will be scheduled for observations of the Crab nebula.

Multi-frequency observations together with the Metshovi Radio Observatory and the optical Tuorla Observatory are planned. The measurements will be correlated with INTEGRAL and GLAST results, when available. X-ray monitoring using the SWIFT and Suzaku facilities will be proposed.

The black hole mass and accretion rate will be determined from the emission models. Estimates of the black hole mass from emission models, a possible orbital modulation, and the Magorrian relation (Magorrian et al. (AJ, 1998)) will be compared.

Hadronic emission processes and possible coincidences between VHE γ- and neutrino-emission, predicted e.g. by Mücke et al. (APh, 2003) and Mannheim (A&A, 1993), will be investigated.

Furthermore, we seek to obtain know-how for the operation of future networks of robotic Cherenkov telescopes.

Technical setup At the MAGIC site the mount of the former HEGRA telescope CT3 is still operational. By building a camera with new generation photomultipliers, improved reflectivity of the lightguides, much higher sampling speed and an increase of the mirror area from 8.5 m^2 to 13 m^2 the sensitivity will be enhanced by a factor of 2.5 with respect to the former HEGRA CT3, whereas the energy threshold will be lowered from 700 GeV to 300 GeV. If development of G-APDs (QE >50%) will be fast enough, the sensitivity can furthermore be increased and the threshold be lowered by factors of 1.6 and 2, respectively.

Conclusion The setup of a small telescope dedicated for long-term AGN monitoring (DWARF) is easily feasible. Such an activity is motivated by a variety of physical questions to be answered by the integration of this instrument in multiwavelength observations.

Future extensions The known duty cycle of 10% ($\sim$1000 h/year) limits the time-coverage of the observations. Therefore we propose a worldwide network of (<10) small scale Cherenkov telescopes to be build in the future, allowing 24 h monitoring of the bright AGNs. Such a system is so far completely unique in this energy range.

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